Amendments to the Specification

Please replace the paragraph beginning on page 5 at line 5 with the following amended paragraph:

B1

In one aspect of the present invention, apparatus is provided for a sending station operable to send a communication signal representative of data which is to be communicated to a receiving station. At the sending station, the data which is to be communicated is encoded by a ~~state-time~~ space-time encoder which performs ~~trellils~~ trellis coding of the data to form a space-time code representative of a coded representation of the data which is to be communicated. The encoder includes a recursive [[,]] feedback path, and the encoder is constructed such that the space-time code formed thereat is both systematic and recursive. The space-time code is of characteristics to facilitate its communication upon communication channels having communication paths which exhibit fading.

Please replace the paragraph beginning on page 14 at line 7 with the following amended paragraphs:

B2

In order to enforce the desirable equal singular value (ESV) structure to valid 1 x L matrices $\mathbf{D}_{ec}$ is sufficient to enforce it on submatrices. Suppose that L divides 1. Let $\mathbf{D}_c$, $\mathbf{D}_e$, $\mathbf{D}_{ec}$ be viewed as block vectors, i.e. (1/L) x 1 matrices whose entries are L x L sub-matrices with elements from M. Then any code matrix can be regarded as a sequence of 1/L, L x L square sub-matrices, resulting from the unfolding of a trellis whose branches span, each, L modulator symbol epochs, with each branch labeled by a valid L x L sub-matrix [[,]]. A path through the trellis is selected as a function of the current state and a block of new input symbols. The set of all L x L matrix building blocks can be regarded as a ~~superconstellation~~ super-constellation. If these

constituent blocks have the property that the Gram matrix of any valid pairwise differences is optimal - or close to optimal - then the properties mentioned above are transferred from $\mathbf{D}_c$, $\mathbf{D}_e$, $\mathbf{D}_{ec}$.

For L = 2 and 4PSK, the 16 orthogonal complex matrices discussed in the existing art do have the aforementioned ESV structured for their pairwise differences. However, in order to achieve the desired $\log_2 M$ b/s/Hz one must have enough L x L constituent matrices in the super-constellation; this requires augmenting the optimal matrix set e.g., by a reflection of itself, to the effect that some code matrix pairs in the augmented set will not obey the ESV structure. The design goal is to ensure that different code matrices pertaining to an error event path (EEP) of length $k \leq k'$ transitions (kL modulator symbols) be optimal for k' as large as possible, and as close to optimal as feasible for $k > k'$. ~~Nnote~~ Note that Alamouti's transmit diversity scheme ~~[1]~~ for L = 2 transmit antennas can be used by simply appending, to any encoder's output, a mapper from encoded symbols to constellation points, followed by a Hurwitz-Radon transformer applied to two consecutive complex symbols. This provides only diversity gain and is not the approach taken herein. It is worth realizing that the Alamouti scheme with 4PSK and two transmit antennae over additive white Gaussian noise (AWGN) has the same bit error probability as uncoded 4 PSK in AWGN. In subsequent plots, Alamouti's scheme serves as a ~~full diversity~~ full-diversity, no coding gain [[,]] reference.

B?

Please replace the paragraph beginning on page 15 at line 12 with the following amended paragraphs:

Consider the $L = 2$ case and assume that each transmit antenna uses 4PSK modulation; other M-PSK constellations can be accommodated using similar steps. A trellis coded modulation scheme with q states, where each trellis transition covers two symbols, can be obtained naturally by constructing a super-constellation whose points are 2 x 2 matrices chosen so as to facilitate the existence of the structure discussed above; the matrix elements are from 4PSK constellation and there must be enough super-constellation points to allow the transmission of 2 bits per channel use. Thirty-two matrices C_i defines the 4PSK symbols to be sent over the $L = 2$ transmit antennae, during two consecutive symbol epochs. The squared Euclidean distance between C_i and C_j is $\mathrm{tr}((C_i\text{-}C_j)^{+}((C_i\text{-}C_j)$. The super-constellation will be partitioned in the usual way, producing [[,]] cosets as a function of q. The elements within ~~on~~ one coset are distinguished by means of uncoded bits.

B3

Finally, the convolutional code selecting the cosets is described in terms of a matrix G, similar structure with the matrices used to describe the convolutional STCs. Comments on parallel transition follow. The following are true: the minimum Euclidean distance between any two branches leaving (arriving into) a given state is maximized. $\mathbf{D}^{\dagger}_{ec}\,\mathbf{D}_{ec}$ has equal eigenvalues for any $\mathbf{D}_{ec}$ corresponding to EEPs of length $k \leq 2$ (i.e., up to four 4PSK symbols). And, the symbol Hamming distance between any two parallel transitions is 2, thereby the diversity is 2 in rapid fading ~~[6]~~. However, when the new 8- and 16-state STTCM codes are compared with, e.g., Tarokh's 16- and 32-state codes, respectivelly, the latter have a symbol Hamming distance of three hence higher diversity in rapid fading.

Please replace the paragraph beginning on page 16 at line 10 with the following amended paragraph:

B4

In the sequel, a frame has 130 symbols. 1, 2 compare the new ~~TTCM~~ STTCM codes with $q = 8$ and $q = 16$ states, in terms of average frame error probability (FEP), against Alamouti's scheme and several other trellis STCs having the same complexity as the relevant new STTCM code-all in quasistatic fading and at the same spectral efficiency of 2 b/s/Hz.